

[Process Advisor](#)[Alternatives](#)[Search](#)[Links](#)

SAGE

Solvent Alternatives Guide

SAGE is a comprehensive guide designed to provide pollution prevention information on solvent and process alternatives for parts cleaning and degreasing. SAGE does not recommend any ozone depleting chemicals.

SAGE was developed by the Surface Cleaning Program at Research Triangle Institute in cooperation with the U.S. EPA Air Pollution Prevention and Control Division (APPCD).

Process Advisor

Use the Expert System to evaluate your process and generate a ranked list of possible alternative solvents.

Alternatives

Descriptions of all the alternatives in SAGE, including case studies, economic and environmental information, references, etc.

Search

Search the entire SAGE Web site.

[State Information](#) | [Glossary](#) | [Process Checklist](#) | [Comments](#)

[Process Advisor](#) | [Alternatives](#) | [Search](#) | [Links](#) | [Connection Module](#)

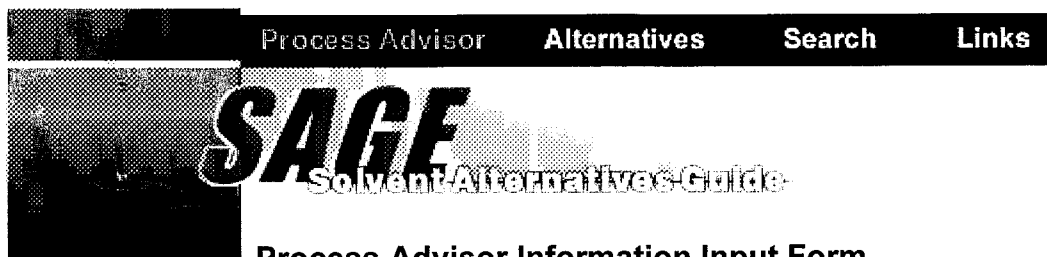
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sage@rti.org

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Process Advisor Information Input Form

State Information

Glossary

Conversion Checklist

Comments

Your answers to the following questions will assist in determining those solvent/process alternatives most likely to work for your particular circumstances.

The "More Info..." symbol: will provide additional explanations for particular questions. Select the response that most closely matches the particular part(s) that you are dealing with.

After you press the "Send Data" button, you should immediately save the page that SAGE returns to you in a local file. This page is generated "on the fly" and does not exist with an URL that can be retrieved later. **Do not** bookmark the page, you won't get it back. To save the page, use the "Save As" function built in to your Web browser. For example, in Netscape you would click on "Save As" and then rename the file (or use the existing name) with either a *.txt (for ASCII text) or *.htm (for HTML) file extension.

Report Header Information

Your Name

Part/Process Name

State of Residence

COLORADO

Physical Properties

Select from each column

(Hold down the control key while using the mouse to select multiple items)

Metallic Materials

Nonmetallic Materials

None	None
300 Series Stainless	Acrylonitrile/Butadiene/Styrene (ABS)
400 Series Stainless	Epoxyes
Other Stainless Steels	Fluoropolymers
Cast Iron	Phenolics
High Carbon Steel	Poly(amide/imide)

If the part is metallic, is it sintered or made from powdered metal:

Yes No NA

Does the part have any polished, lapped, or ground surfaces that must be protected:

What must be protected:

Yes No ?

Is the part an assembly or a single piece part:

Assembly Single piece part ?

Size/Shape Characteristics ?

Is the part volume:

less than 1 ft³ between 1 and 9 ft³ more than 9 ft³

Is the longest rigid length of the part:

less than 1 ft between 1 and 5 ft more than 5 ft

Does the part have a complex shape:

Yes No

Does the part have blind holes:

Yes No

Coatings ?

Does the part have any type of coating:

Yes No

Do you want to remove the coating:

Yes No NA

Is the coating:

A plating A paint or powder coat A thin film deposition
A phosphate prep Some other coating Not applicable

Cleanliness Requirements

Please select the type of contaminant or soil you are removing:

(Hold down the control key while using the mouse to select multiple items)

Water soluble process fluids

Particles

Non-water soluble process fluids

Adhesive residues

Drawing compounds

Rust

Is your part subject to cleanliness inspection per a national, internal, or customer specification:

Yes No

Is your part inspected per MIL-STD-1246C:

Yes No ?

Will your part be used in a Class 100 or better clean room:

Yes No

What is the next process step your product will see:

Packaging for shipment
More processing, with the same fluids
More processing, with different fluids
Coating
Assembly into another part
Assembly or test in a clean room

Does the part need to be dry after this cleaning step:

Yes No

Miscellaneous Process Information

What kind of cleaning equipment are you currently using:

Vapor degreaser
Ultrasonic vapor degreaser, with spray and/or heaters
Cold immersion tank
Hot immersion tank
Power washing machine
Some other type of equipment

What type of chemicals are you currently using:

(Select only one)

Methyl chloroform (1,1,1-trichloroethane, TCA)
CFC-113 (trichlorotrifluoroethane)
Methylene chloride
Methyl ethyl ketone (MEK)
Trichloroethylene (TCE)
Kerosene

Do you currently have DI (deionized) or tap water available:

DI water Tap water Neither

How many parts per hour do you need to clean:

More than 100 Between 10 and 100
Less than 10 per hour Production rate varies widely

Is the part a high dollar value part:

Yes No

Will ultrasonic vibrations hurt your part:

Yes No Don't know

Can your part withstand high atmospheric pressure:

Yes No

Can your part withstand high pressure sprays:

Yes No Don't know

[Enter Data](#)

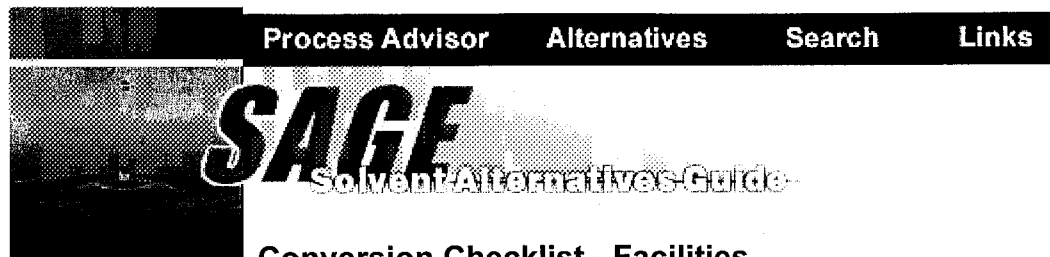
[State Information](#) | [Glossary](#) | [Conversion Checklist](#) | [Comments](#)[Home](#) | [Process Advisor](#) | [Alternatives](#) | [Links](#) | [Search](#)

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**Conversion Checklist - Facilities**

Facilities | Process | Regulatory | Safety

State Information**Glossary****Conversion Checklist****Comments**

- ⌘ Are existing chemical handling facilities/practices applicable?
- ⌘ Are existing handling facilities/practices adequate?
- ⌘ Are existing handling facilities/practices excessive or can they be simplified?
- ⌘ Have closed-loop recycle and reuse within the plant been investigated?
- ⌘ Is there sufficient space for any necessary new equipment or to retrofit old equipment?
- ⌘ Is there enough space to hold parts to dry if a longer time is required?
- ⌘ Is the material of your existing equipment compatible with your new chemistry/process?
- ⌘ Do recycling facilities need to be added?
- ⌘ Is humidity control adequate?
- ⌘ Are pumps adequate?
- ⌘ Will scale build-up be a problem?
- ⌘ Will additional electricity be required?
- ⌘ Will additional vents or drains be required.
- ⌘ Will more water be needed?
- ⌘ Is additional water available from other processes in the plant or will total plant intake need to be increased?
- ⌘ Is additional water available to your plant (will depend on geographic region)?
- ⌘ Is existing plumbing is adequate?
- ⌘ Is the water supply clean enough and, if not, are facilities available to clean the water (distill, deionize, filter)?

- ⌘ Will the volume of wastewater generated onsite change?
- ⌘ Will this be a problem for your onsite water treatment, if applicable?
- ⌘ Will the contents or temperature of your onsite wastewater change?
- ⌘ Will your on-site system accommodate any changes?
- ⌘ Will the volume of wastewater discharged to the sewer change?
- ⌘ Will the contents or temperature of the water stream discharged to the sewer change?
- ⌘ Do you need to adjust the pH of your wastewater stream?
- ⌘ Is available air clean/dry enough for drying or other processes and, if not, what pretreatment (dehumidification, filtration, etc.) will be needed?
- ⌘ Is needed air pretreatment currently available?
- ⌘ Will the volume, content, temperature, or location of air emissions change?
- ⌘ Will the emissions require a change in stack or local air cleaners?
- ⌘ Will the volume or contents of solid waste change?
- ⌘ Will the waste be classified as hazardous?
- ⌘ Will hazardous waste treatment/disposal be needed onsite or offsite?
- ⌘ Will you need hazardous waste treatment/disposal?

[State Information](#) | [Glossary](#) | [Conversion Checklist](#) | [Comments](#)

[Home](#) | [Process Advisor](#) | [Alternatives](#) | [Links](#) | [Search](#)

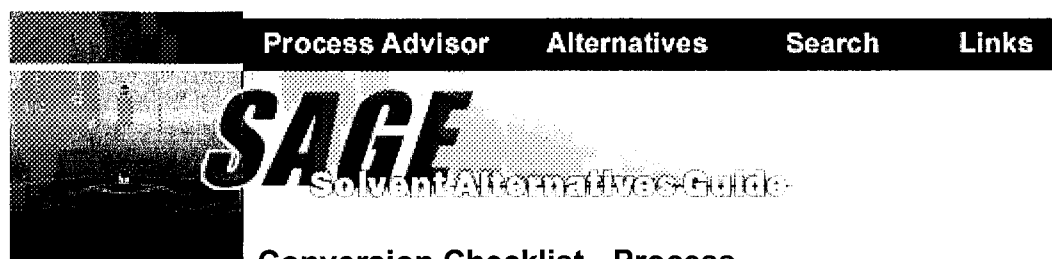
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Conversion Checklist - Process

Facilities | Process | Regulatory | Safety

State Information

Glossary

Conversion Checklist

Comments

- ⌘ Is the material of the parts compatible with the proposed process/chemistry?
- ⌘ Will the cleaning be batch or continuous?
- ⌘ Will the process be automated?
- ⌘ What are the financial limitations on new equipment purchases?
- ⌘ Is the new process labor intensive relative to the old process?
- ⌘ Will the cleaning process affect the upstream or downstream processes? (For example will a change in lubricants be needed to be compatible with the new cleanser; will the time required in the drier be compatible with current throughput rate?)
- ⌘ Will the cleaning process harm the surface of the part?
- ⌘ Will additional surface preparation be needed after cleaning?
- ⌘ Is an acceptable and sufficient quantity of the new chemical or equipment available at reasonable cost?
- ⌘ Can current equipment be used as is (drop-in substitution)?
- ⌘ Can existing equipment be retrofit for the proposed method?
- ⌘ Is retrofit more economical than equipment replacement?
- ⌘ Is the material of your existing equipment compatible with your new chemistry/process? (For example, will there be corrosion, embrittlement, chemical reaction, heat transfer difficulties, or pressure containment?)
- ⌘ Will scale buildup be a problem?
- ⌘ Is sufficient containment available (shielding for spraying, edges to prevent drips)?
- ⌘ Is humidity control adequate?
- ⌘ Are pumps adequate?

- ⌘ Are closed-loop recycle and reuse practical within the process?
- ⌘ Will the wastewater include biocides, foaming agents, or metals?
- ⌘ Will contracts need to be changed to reflect new cleaning method?
- ⌘ Will the product meet quality specifications including applicable MIL specifications?
- ⌘ Will customer require proof that specifications are met and, if so, what kind?
- ⌘ Is resistance to the changes likely?
- ⌘ What type of training should be set up?
- ⌘ Are incentive programs or monitoring programs appropriate for your facility?

[State Information](#) | [Glossary](#) | [Conversion Checklist](#) | [Comments](#)

[Home](#) | [Process Advisor](#) | [Alternatives](#) | [Links](#) | [Search](#)



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Process Advisor Alternatives Search Links		
		
Conversion Checklist - Regulatory		
		Facilities Process Regulatory Safety
State Information		
Glossary		
Conversion Checklist		
Comments		
<ul style="list-style-type: none">⌘ Will a new wastewater stream be allowed to discharge to sewer?⌘ Will adjustments to the pH of the discharge be required?⌘ Will the effluents (air, water, solids) require regulatory reporting under the Toxic Release Inventory (TRI) or elsewhere?⌘ Will the air emissions require a change in stack or local air cleaners?⌘ Will the emissions be classed as a Hazardous Air Pollutant (HAP), or a Volatile Organic Chemical (VOC)?⌘ Will the emissions will be covered under the Superfund Amendment and Reauthorization Act (SARA Title III), the Resource Conservation and Recovery Act (RCRA), or the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)?⌘ Will the effluents require regulatory reporting?⌘ Will the changes reduce regulatory reporting?⌘ Will any solid waste be classified as hazardous?⌘ Will hazardous waste treatment/disposal be needed (onsite or offsite)?⌘ Will new or changed permits be needed for chemical purchase or storage?⌘ Will new or changed permits be needed for water intake changes?⌘ Will new or changed permits be needed for changes in volume, temperature, or contents (including biocides, foaming agents, metals) of water discharged to the sewer?⌘ Will new or changed permits be needed for changes in volume, temperature, or contents of air emissions?⌘ Will new or changed permits be needed for changes in volume or contents of any solid waste?⌘ Even if you do not need a water permit, will you need to notify officials that your use will increase?		

- ⌘ What are the local regulations including biological oxygen demand (BOD) and chemical oxygen demand (COD)?
- ⌘ What is your status with your local publicly owned treatment works (POTW)?

[State Information](#) | [Glossary](#) | [Conversion Checklist](#) | [Comments](#)

[Home](#) | [Process Advisor](#) | [Alternatives](#) | [Links](#) | [Search](#)

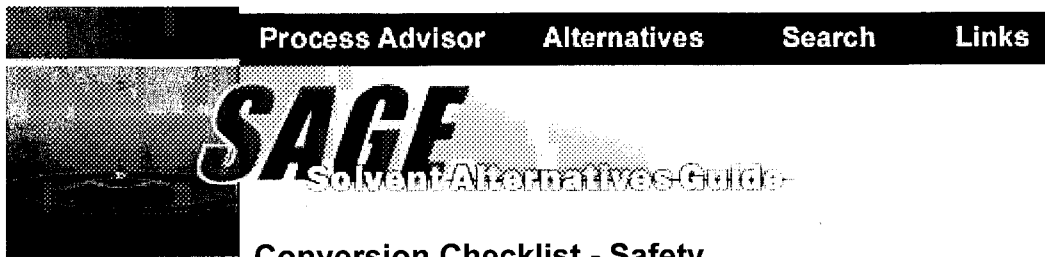
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**Conversion Checklist - Safety**

Facilities | Process | Regulatory | Safety

State Information**Glossary****Conversion Checklist****Comments**

- ⌘ Are your existing handling facilities/practices applicable to the new chemicals?
- ⌘ Are your existing handling facilities/practices adequate?
- ⌘ Are your existing handling facilities/practices excessive and can they be simplified?
- ⌘ Are the new chemicals flammable as stored or as used in the new process?
- ⌘ Are there sufficient procedures in place to avoid hazard?
- ⌘ Do you need to increase, decrease, or maintain operator eye protection?
- ⌘ Do you need to increase, decrease, or maintain operator hearing protection?
- ⌘ Do you need to increase, decrease, or maintain operator breathing apparatus?
- ⌘ Do you need to increase, decrease, or maintain ventilation levels for operator safety?
- ⌘ Do you need to increase, decrease, or maintain air cleaning level to provide operator safety?
- ⌘ Do you need to increase, decrease, or maintain operator protection for possible liquid spills - acids, alkali, heat, toxics?
- ⌘ What are the threshold limit values (TLV's), American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) ventilation standards (including changes since older process implemented), and Occupational Safety and Health Association (OSHA) procedures?
- ⌘ Do you need to revise operator safety training?

State Information | Glossary | Conversion Checklist | Comments

ABC CORPORATION

- Vapor Degreaser - MEK
- Usage - 150 gallons/month average; 200 gallons/month max.
size - 5 ft. wide X 10 ft. high X 20 ft. long.
- Normal operation - 17 hours/day
5 days/week
24 weeks/year
120 days/year
- Miscellaneous - Tap water available.
Due to specifications product is sensitive to ultrasonics, but not high pressures.

Complex, costly parts are received as raw castings from sheets of zinc, aluminum, brass, and 308 stainless steel which are 1 ft. X 2 ft. X 4 ft.

1. Parts are cleaned (using vapor degreaser) for fingerprints and rust.
2. Parts are machined; drill tapped, milled, "Lap" ground; petroleum-based coolants and cutting oils used; some blind holes from drilling.
3. Parts are then cleaned again (using vapor degreaser).
4. Parts are then undercoated and finish painted and cured (must be moisture free to paint).

Vapor degreaser has boiling sump, clean sump and spray wand used by operator for final rinse.

Vertical hoist used to place basket of castings into degreaser. Conveyor speed 30 ft. per minute.



STAMPING INCORPORATION

- Vapor degreaser - Trichloroethane 1, 1, 1
- Solvent usage - 200 gallons/month average; 250 gallons/month maximum.
- Degreaser Size - 5 ft. wide X 10 ft. high X 10 ft. long.
- Normal operation - 24 hours/day
5 days/week
40 weeks/year
200 days/year
- Miscellaneous - Tap water available.
Low value product.
Due to specifications box must withstand high pressures and ultrasonics.

Material received in 4 ft. X 8 ft. sheets (high carbon steel) which are sheered into 4 ft. X 4 ft. sheets.

Material formed (deep draw 300 ton press) into 1.33 ft. X 1.33 ft. X 1.33 ft. boxes with heavy oil, grease and silicone used in draw process.

Box tabs are welded in place (using welding flux).

Boxes are then degreased in vapor degreaser prior to phosphatizing and application of powder coating and curing (must be moisture free to paint) to remove contaminants from processing rust and fingerprints.

Boxes are carried into and out of degreaser by traveling conveyor with rack attachments at 10 ft. per minute.



ELECTRONIC COMPONENTS CORPORATION

- Vapor degreaser - Trichloroethane 1, 1, 1
- Usage - 425 gallons per month average.
800 gallons per month maximum.
- Tank Dimensions - 2 ft. wide X 4 ft. deep X 3 ft. long.
- Time of tank usage - 8 hours/day
5 days/week
50 weeks/year
250 days/year
- Article cleaned - Aluminum complex condensers with zinc plated leads for a PC board around 1" in diameter and 2" long.
- Miscellaneous - Tap water available.
High value part.
Ultrasonics can hurt part can't withstand high pressures or sprays.

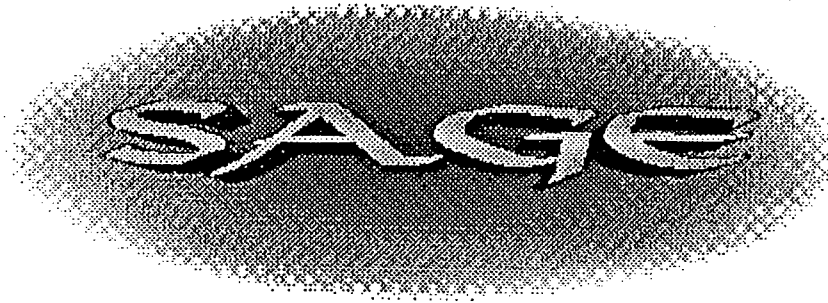
Prior processing:

- * Aluminum tubes drawn from non-sintered sheets.
- * Fiber end pieces epoxied in place.
- * Zinc plated leads soldered internally but have solder flux and silicone grease.

Subsequent process and use:

- * Identification information will be stamped with epoxy ink on non-coated polished condenser capacitor surface.
- * Leads will be soldered in printed circuit board and must be dry and grease free as per PC cleanliness standards.
- * Process runs 2000 parts per hour.





Information Report



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Prepared for: ABC Corp

Part name/number: Parts Washing

State information: KENTUCKY

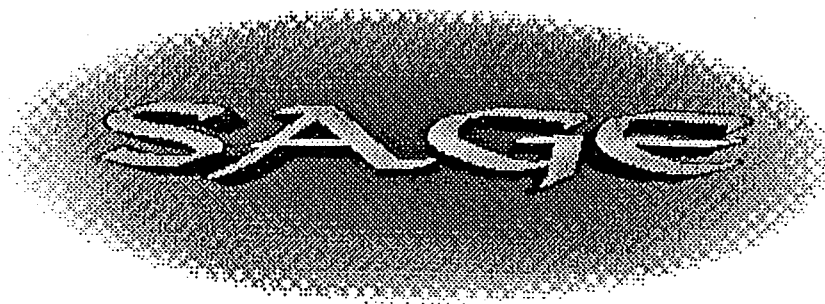
PART/PROCESS CHARACTERISTICS

- Material 1: *300 Series Stainless*
- Material 2: *Aluminum*
- Material 3: *Zinc*
- Material 4: *Brass*
- Material 5: *None*
- Sintered/powder material: *No*
- Polished/lapped surfaces: *Yes*
- Assembly or piece part: *Single piece part*
- Part volume: *Medium*
- Longest rigid length: *Medium*
- Complex shape: *Complex*
- Blind holes: *Yes*
- Any coating: *No*
- Remove the coating: *na*
- Type of coating: *na*
- Contaminant 1: *Non-water soluble process fluids*
- Contaminant 2: *Rust*
- Contaminant 3: *Fingerprints*
- Contaminant 4: *Oil*
- Contaminant 5: *Tapping compounds*
- Cleanliness specification: *Yes*
- Inspected per MIL-STD-1246c: *No*
- Used in a Class 100 or better cleanroom: *No*

- Next processing step: *Coating*
- Part must be dry: *Yes*
- Current equipment: *Vapor degreaser*
- Current cleaning chemical: *Methyl ethyl ketone (MEK)*
- DI or tap water available: *Tap*
- Parts per hour to clean: *Medium*
- High dollar value part: *Yes*
- Harmed by ultrasonic vibrations: *No*
- Withstand high atmospheric pressure: *No*
- Withstand high pressure spray: *Yes*

ALTERNATIVE EVALUATIONS

Chemistry Alternatives		Process Alternatives	
ALTERNATIVE	RELATIVE SCORE	ALTERNATIVE	RELATIVE SCORE
Alkaline Aqueous Solutions	86	High Pressure Spray	99
Ethyl Lactate	84	Power Washer	99
Terpenes	83	Ultrasonics	99
Surfactants	79	Semiaqueous Cleaning	88
N-methyl Pyrrolidone	66	Low Pressure Spray	86
Glycol Ethers	63	Immersion Cleaning	85
Neutral Aqueous Solutions	62	Steam	85
Petroleum Distillates	60	Brushing	75
Dibasic Esters	59	Megasonics	71
Inhibiting Agents	59	CO2 Snow	57
Emulsifiers	57	Wiping	50
Acetone	53	Supercritical CO2	50
Alcohol	53	CO2 Pellets	46
Acidic Aqueous Solutions	33	Abrasives	46
Pure Water	22	UV/Ozone Cleaning	33
Builders	0	Plasma	28
Sequestering Agents	0	Xenon Flash Lamp	12
Chelating Agents	0	Laser Ablation	6
		Fiberglass Mold Cleaning	0
		Standard Paint Stripping Techniques	0
		Printed Circuit Board Assemblies	0



Information Report



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Prepared for: Stamping Inc

Part name/number: Parts Washing

State information: KENTUCKY

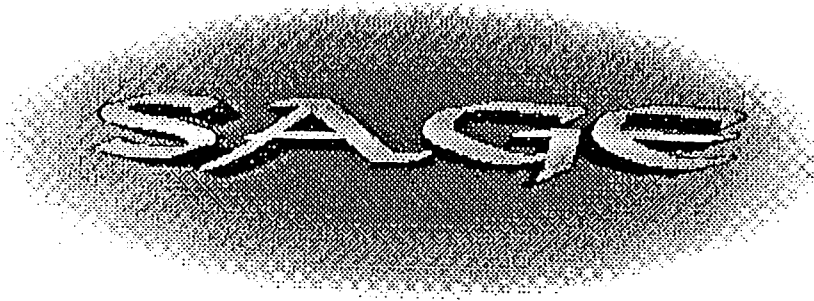
PART/PROCESS CHARACTERISTICS

- Material 1: *High Carbon Steel*
- Material 2: *None*
- Sintered/powder material: *No*
- Polished/lapped surfaces: *No*
- Assembly or piece part: *Single piece part*
- Part volume: *Medium*
- Longest rigid length: *Medium*
- Complex shape: *Simple*
- Blind holes: *No*
- Any coating: *No*
- Remove the coating: *na*
- Type of coating: *na*
- Contaminant 1: *Grease*
- Contaminant 2: *Silicones*
- Contaminant 3: *Some other contaminant*
- Cleanliness specification: *Yes*
- Inspected per MIL-STD-1246c: *No*
- Used in a Class 100 or better cleanroom: *No*
- Next processing step: *Coating*
- Part must be dry: *Yes*
- Current equipment: *Vapor degreaser*
- Current cleaning chemical: *Methyl chloroform (1,1,1-trichloroethane, TCA)*
- DI or tap water available: *Tap*

- **Parts per hour to clean:** *Medium*
- **High dollar value part:** *No*
- **Harmed by ultrasonic vibrations:** *No*
- **Withstand high atmospheric pressure:** *Yes*
- **Withstand high pressure spray:** *Yes*

ALTERNATIVE EVALUATIONS

Chemistry Alternatives		Process Alternatives	
ALTERNATIVE	RELATIVE SCORE	ALTERNATIVE	RELATIVE SCORE
<u>N-methyl Pyrrolidone</u>	98	<u>Ultrasonics</u>	99
<u>Ethyl Lactate</u>	98	<u>High Pressure Spray</u>	99
<u>Terpenes</u>	98	<u>Brushing</u>	99
<u>Surfactants</u>	95	<u>Wiping</u>	99
<u>Inhibiting Agents</u>	91	<u>Megasonics</u>	99
<u>Alkaline Aqueous Solutions</u>	74	<u>Immersion Cleaning</u>	99
<u>Emulsifiers</u>	70	<u>Low Pressure Spray</u>	99
<u>Neutral Aqueous Solutions</u>	70	<u>Steam</u>	99
<u>Glycol Ethers</u>	66	<u>Power Washer</u>	99
<u>Dibasic Esters</u>	66	<u>Semiaqueous Cleaning</u>	98
<u>Alcohol</u>	55	<u>CO2 Pellets</u>	79
<u>Acetone</u>	55	<u>Abrasives</u>	79
<u>Pure Water</u>	49	<u>Supercritical CO2</u>	74
<u>Acidic Aqueous Solutions</u>	42	<u>CO2 Snow</u>	70
<u>Petroleum Distillates</u>	33	<u>Plasma</u>	70
<u>Builders</u>	0	<u>UV/Ozone Cleaning</u>	49
<u>Sequestering Agents</u>	0	<u>Xenon Flash Lamp</u>	33
<u>Chelating Agents</u>	0	<u>Laser Ablation</u>	20
		<u>Fiberglass Mold Cleaning</u>	0
		<u>Standard Paint Stripping Techniques</u>	0
		<u>Printed Circuit Board Assemblies</u>	0



Information Report



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Prepared for: ECC

Part name/number: Parts Cleaning

State information: KENTUCKY

PART/PROCESS CHARACTERISTICS

- Material 1: *Aluminum*
- Material 2: *Zinc*
- Material 3: *None*
- Sintered/powder material: *No*
- Polished/lapped surfaces: *No*
- Assembly or piece part: *Assembly*
- Part volume: *Small*
- Longest rigid length: *Small*
- Complex shape: *Complex*
- Blind holes: *No*
- Any coating: *No*
- Remove the coating: *na*
- Type of coating: *na*
- Contaminant 1: *Grease*
- Contaminant 2: *Silicones*
- Contaminant 3: *Some other contaminant*
- Cleanliness specification: *Yes*
- Inspected per MIL-STD-1246c: *No*
- Used in a Class 100 or better cleanroom: *No*
- Next processing step: *Assembly into another part*
- Part must be dry: *Yes*
- Current equipment: *Vapor degreaser*
- Current cleaning chemical: *Methyl chloroform (1,1,1-trichloroethane, TCA)*
- DI or tap water available: *Tap*

DI or tap water available: *Tap*

- Parts per hour to clean: *High*
- High dollar value part: *Yes*
- Harmed by ultrasonic vibrations: *Yes*
- Withstand high atmospheric pressure: *No*
- Withstand high pressure spray: *No*

ALTERNATIVE EVALUATIONS

Chemistry Alternatives		Process Alternatives	
ALTERNATIVE	RELATIVE SCORE	ALTERNATIVE	RELATIVE SCORE
Surfactants	98	Power Washer	99
N-methyl Pyrrolidone	98	Low Pressure Spray	99
Ethyl Lactate	98	Immersion Cleaning	98
Terpenes	97	Steam	74
Inhibiting Agents	95	Brushing	74
Builders	91	Semiaqueous Cleaning	70
Alkaline Aqueous Solutions	66	Abrasives	59
Neutral Aqueous Solutions	66	CO2 Pellets	45
Alcohol	49	CO2 Snow	42
Acetone	49	High Pressure Spray	33
Emulsifiers	42	Ultrasonics	33
Pure Water	42	Wiping	33
Glycol Ethers	32	Plasma	25
Dibasic Esters	32	Supercritical CO2	25
Petroleum Distillates	25	Megasonics	14
Acidic Aqueous Solutions	20	UV/Ozone Cleaning	11
Sequestering Agents	0	Xenon Flash Lamp	0
Chelating Agents	0	Fiberglass Mold Cleaning	0
		Laser Ablation	0
		Standard Paint Stripping Techniques	0
		Printed Circuit Board Assemblies	0